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Analogy 1.0

A Wildlife Population Model

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Manitoba
Natural Resources
Wildlife Branch
Biological Services

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Preface

Disclaimer

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1 Introduction

Welcome to *Analogy*. This chapter gives a brief overview of *Analogy*, the assumptions of the model and a discussion on inaccuracies. Information on using this manual, required equipment, and installation is also included in this chapter.

What is Analogy ?

Analogy was developed to give wildlife managers a fast and flexible tool for forecasting the dynamics of wildlife populations. It was developed to be easy to use, requiring little previous experience on computers.

Analogy allows you to define a population by way of Parameters. These include data such as age-specific natality rates, the starting population, the age structure of the population, etc.. Once the population is defined, you may create up to 25 separate Factors that affect the population during its annual reproductive cycle. The Factors can be anything that results in a removal or addition of animals to the population including postnatal mortality, wolf mortality, licensed sport harvest, road kills, diseases, stocking programs, immigration, etc.. Each factor can be turned on or off for each year in the simulation, allowing for maximum flexibility in doing what-if or sensitivity analysis.

After all Parameters and Factors are specified the model is run and the results tabulated. *Analogy* has the capability to simulate up to 10 years at a time (there are ways to simulate for an indefinite period of time, more about this later). Results can be viewed on the computer monitor and optionally printed to a printer.

All Parameters and Factors can be saved to disk and retrieved at a later date for modification or use.

Whats In the Manual

Following is a list of the chapters and appendices of this manual with a brief description of the contents of each. Although this manual does not contain a tutorial Chapter VII contains a number of step by step examples of running though some simulations.

Chapter I, "Introduction", contains an overview of *Analogy* and important information about installing and using the program. It is recommended that all users read this chapter.

Chapter II, "Parameters", discusses the inputting of population parameters.

Chapter III, "Factors", contains information about manipulating the list of extrinsic Factors that affect the population.

Chapter IV, "Modifying A Factor", describes how to manipulate each Factor in the Factor List.

Chapter V, "File Menu", describes how to load, save, clear, erase and print Parameter files. It also describes how to change certain output options of the model from the File Menu.

Chapter VI, "Running", contains information about running a simulation and viewing the results.

Chapter VII, "Tips and Techniques", discusses using examples the concepts of doing sensitivity analysis and what-if analysis. It also describes how to simulate more than 10 years. This chapter can be used as a tutorial for inexperienced users.

Appendix I summarizes the mathematical equations used in the simulation process of *Analogy*.

Appendix II contains answers to commonly asked questions.

Assumptions

It is said that "A model is only as good as its assumptions.". All models make assumptions and *Analogy* is no exception. The reader should fully understand these assumptions and be able to evaluate the consequences involved in making and/or violating them.

Analogy is strictly deterministic in nature, it does not involve any stochastic processes. This means that there is no attempt to incorporate any random processes in the simulation. Once the information necessary to run the model is specified there is only one possible result.

There are no homeostatic processes or bio-feedback mechanisms such as density dependent birth and death rates built in to *Analogy*. You should be aware of the possible consequences of this fact. For example, in nature, a continuously decreasing male segment of a population would, at some point, influence the impregnation rate of the females in the population, causing a decrease in overall production. In *Analogy*, a similar decrease in the number of males would have no effect on the number of females becoming impregnated, and therefore no effect on the population reproduction. You can simulate such conditions by changing the parameters of the simulation on a yearly basis to incorporate dependencies on population densities.

Assumptions the model makes are:

1. *Analogy* is deterministic, stochastic processes have not been built in to the algorithms.
2. The species being modelled has an annual schedule of reproduction.
3. The maximum attainable age of the species being modelled is less than or equal to 30 years. Or, at least, a significant portion of the population does not survive beyond 30 years of age.
4. The population being modeled will not exceed one million animals.
5. The species is polygynous.
6. The species is not limited by any density dependent relationships.
7. Factors that affect the population do so independently and in a pre-describable order.
8. There is no differential mortality of young of the year animals (i.e. both male and female young of the year are equally vulnerable to Factors).

9. The user has the following information available :

a) the number of animals in the population just prior to reproduction.

b) the age and sex structure of the population.

c) the number (or percent) of animals lost (or added) to the population for each Factor specified.

d) the relative vulnerability of each age and sex class to each Factor specified (in absence of these data equal vulnerability can be assumed).

e) the age specific natality rates of females in the population.

Inaccuracies

Two types of inaccuracies can occur in *Analogy*: the first is caused by the internal representation and manipulation of numbers; the second results from inputting errors and the use of erroneous data for the Parameters and Factors.

All attempts have been made to minimize the first type of inaccuracies, those caused by the internal representation and manipulation of numbers. These would include rounding errors, ill-conceived algorithms, etc.. For those interested, double precision floating point numbers with 15 significant digits are used for all non-integer values in the model. Algorithms were tested with a variety of input values but it is impossible to test the model with every conceivable combination of input values. With this in mind, you should verify results obtained by *Analogy* to your own satisfaction as we cannot guarantee they are error free. If you encounter these types of errors, contact the author and attempts will be made to fix them.

You are in control of the second type of inaccuracies, those caused by inputting errors and the use of inaccurate data. "Garbage in, Garbage out...", this phrase is especially appropriate for modelling. Enter information that is inaccurate and *Analogy* will intensify it, not compensate for it. If inaccurate data are used in the Parameters, the results of the first year of simulation may be somewhat distorted. These distorted results will then be used to simulate the next year, and the inaccurate parameter(s) will be used again, causing even a greater distortion in the second year results. It is easy to see that inaccuracies of this type can compound exponentially throughout the simulation. *Analogy* will be more sensitive to inaccuracies in some Parameters and Factors than others. If interested, you can do your own sensitivity analysis to determine which ones these are.

If used in the proper context, that is, as one tool out of many you have available to you, *Analogy* may be able to provide some additional insight into the decision making process of managing wildlife populations. This is the intended use for *Analogy*.

Algorithmic Considerations

This section discusses two important facts about the way *Analogy* handles numbers during a simulation.

Firstly, numbers displayed in the results are truncated to the nearest integer value (this does not affect their internal representation). This means that if, internally, the number of males was 123.654365 the number displayed on the screen and printed on the results would be 123.

Secondly, if, at any time, the number of animals in a particular age-sex class falls below zero the number is set to zero. This fact is important when viewing results because it may lead to some discrepancies between what is expected and what occurs. For example, if you had a population with 100 twenty year old males and you input a Factor that was to remove 123 twenty year old males, only 100 would actually by removed because that's all there was to remove. In the results you would notice that your Factor only removed 100 animals instead of the expected 123. No attempts are made by *Analogy* to redistribute the Factor when this occurs.

Specific equations for some calculations are listed in appendix I.

Manual Conventions

Typefaces...

ANY TEXT IN THIS TYPEFACE SHOULD BE ENTERED EXACTLY AS SHOWN AT THE KEYBOARD.

Keys...

Analogy uses special key strokes to access different parts of the program. These keys are sometimes referred to as Function keys or Control keys. Throughout this manual these keys will be depicted inside square brackets [], for example reference to [F1] means the user should press F1 (usually located at the top left of the keyboard). Another convention used throughout this program is the representation used for key combinations. Key combinations also appear in square brackets, an example is [Ctrl-Enter], this instructs you to press down and hold the [Ctrl] key while simultaneously pressing the [Enter] key. Due to limitations imposed by the physical size of the display screen there are two special symbols used in *Analogy*, one is "^" and the other is "↑". These symbols are synonymous with [Ctrl] and [Shift] respectively, for example [↑F1] equates to [Shift-F1] and [^Enter] equates to [Ctrl-Enter].

The following keys have a consistent meaning throughout *Analogy* :

[F1]	Access to context sensitive help.
[↑F1]	Keys help.
[F2]	Allows you to move and re-size the current window.
[Shift-F10]	Display the **"Analogy 1.0"** window.
[Esc]	Exit from current window cancelling all changes.
[Ctrl-Enter]	Exit from current window and make all changes permanent.

Other keys will be discussed in the sections where they are relevant.

Installation

What you need...

To run *Analogy* you will require an IBM PC, XT, AT or compatible with at least 256k of memory and one floppy disk drive. You should also have MS-DOS or PC-DOS 3.2 or later. Although a printer is optional it is highly recommended as it is the only way to obtain hard copies of the results. Any standard printer should work with *Analogy*.

What you should know...

This manual assumes that you know some basic DOS commands in order to install the program on a hard disk. You should know how to create directories, copy files and execute programs. Knowledge of DOS file naming conventions and wild-card specifications would also be useful. If you need more information on these topics please refer to the DOS users guide supplied with your version of DOS.

What's on the disk...

There are three files on the *Analogy* diskette, they are 'analogy.exe', 'analogy.msg' and 'analogy.ndx'. 'Analogy.exe' is the actual program file, 'analogy.msg' and 'analogy.ndx' are files required by the help system.

Hard disk...

To install on a hard disk it is recommended that *Analogy* be put in its own directory. Create a directory by typing in the following from the `C:\>` prompt :

`MD C:\ANALOGY` , and press the [Enter] key.

Once this directory is created you can copy the three files to this directory by typing in the following line (make sure the floppy disk is in drive A:) :

`COPY A:\*.* C:\ANALOGY\*.*` , and press the [Enter] key.

Floppy disk...

The program can be run as is from the floppy disk, no further installation is required.

Getting Started

To run the program, first make the directory containing *Analogy* the active directory (or make the floppy disk the active disk in the case of a floppy disk system). You do this by typing in the following :

Hard Disk...

`C:` , and press the [Enter] key,
`CD \ ANALOGY` , and press the [Enter] key.

Floppy Disk...

`A:` , and press the [Enter] key, (assuming you are using drive A).

Running...

Once this is done you can run *Analogy* by typing

`ANALOGY` , and pressing the [Enter] key.

Colours...

Analogy automatically detects whether you have a colour or monochrome video adapter in your computer. Some computers however, have a colour video adapter and a monochrome monitor (some laptops for example). In this situation you may want to override this detection logic and load the monochrome screen configuration instead of the default colour configuration. To do this you can use the -B command line switch. The following example will load the monochrome configuration even if a colour video adapter is detected :

`ANALOGY -B` , and press the [Enter] key.

Sound...

For those of you who find the usual "beeps" made when an error is detected extremely annoying you can turn the sound off with the command line switch -S. The syntax would be the same as above except substitute -S for the -B.

ANALOGY -S , and press the [Enter] key.

The above two command line switches can be combined by entering :

ANALOGY -B -S , and pressing the [Enter] key.

What you see...

Once you have executed *Analogy* you will see the opening screen. Figure 1 shows the initial screen display when *Analogy* is executed.

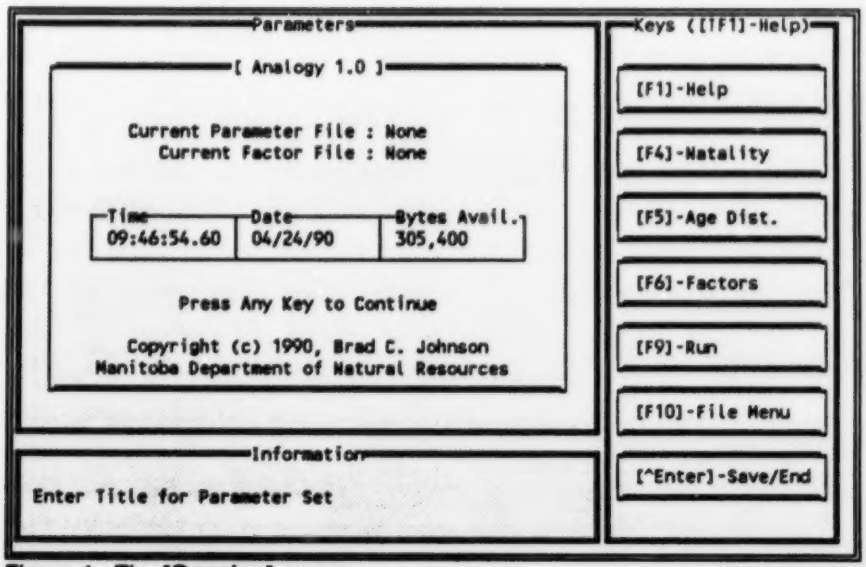

Figure 1. The "Opening" screen.

About Windows...

As various aspects of *Analogy* are accessed text windows "pop-up" on the screen. You can move these "pop-up" windows around on the screen by using the "window re-size key" described below. When some of the windows "pop-up" on the screen they are not large enough to contain all of the information available and some information is hidden from view. If there is more information available "scroll-bars" will appear as hash marks on the borders of the window (in Figure 2 the scroll-bars are in boldface type on the left and bottom borders of the "**Summary of 1990**" window). By using the cursor keys, the information hidden from view can be accessed. The "scroll bars" indicate your position within the underlying information. To help visualize this, consider trying to read a newspaper with a magnifying glass. As you move the magnifying glass around, different parts of the newspaper become visible and some become hidden. The windows in *Analogy* work the same way (you might even say it's analogous) except that the magnifying glass (the window) is kept in a fixed position while the newspaper is moved.

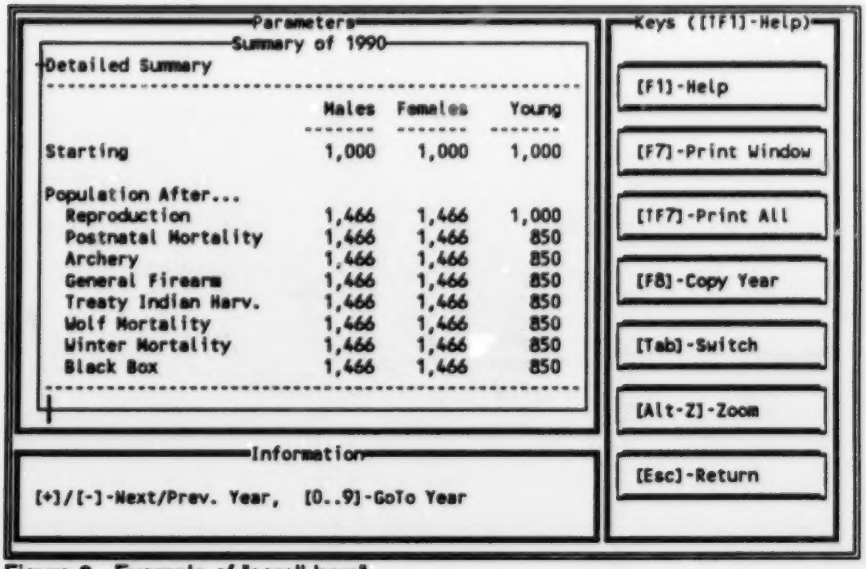

Figure 2. Example of "scroll-bars".

Of particular interest are the **"Keys"** window and the **"Information"** window (see Figure 2), these two windows are always present (although they might be hidden).

Keys Window...

The **"Keys"** window (located on the right of the screen) contains a partial list of Function/Control keys available to the you at any particular time along with a brief description of what each does. A complete list of keys and descriptions of each can be accessed by pressing [Shift-F1].

Information Window...

The **"Information"** window (located in the lower left corner of the screen) contains a short message about what is expected from you at a particular point. For instance, if you were currently positioned in the **"Title"** field of the **"Parameters"** window the message "Enter Title for Parameter Set" would be displayed in the **"Information"** window.

Moving and Re-sizing Windows...

Windows can be moved around on the screen and made larger or smaller (the **"Keys"** and **"Information"** windows cannot be moved or re-sized). To accomplish this press [F2]. A message at the bottom of the screen will describe how to move or re-size the windows.

Getting Help...

As mentioned previously there are two kinds of help available. Context sensitive help is available by pressing [F1], whereupon a window will pop up on the screen that will describe in more detail what is expected at any given time.

Pressing [Shift-F1] ([↑F1]) will pop up a window showing a complete list of special keys that can be used at a particular point in the system. As explained earlier, this is an expansion of the **"Keys"** window described above.

If, after referring to these two screens, you are still confused, you may have to refer to the appropriate section of the manual for more information.

II Parameters

The Parameters can be thought of as the skeleton of the population. This is where you define the population which is to be modelled and the time frame of the simulation. All other aspects of *Analogy* are accessed from this screen. This chapter discusses the fields in the **"Parameters"** window and the keys that can be used from there.

When you run *Analogy* and press any key to clear the copyright window you are positioned in the **"Parameters"** window (Figure 3).

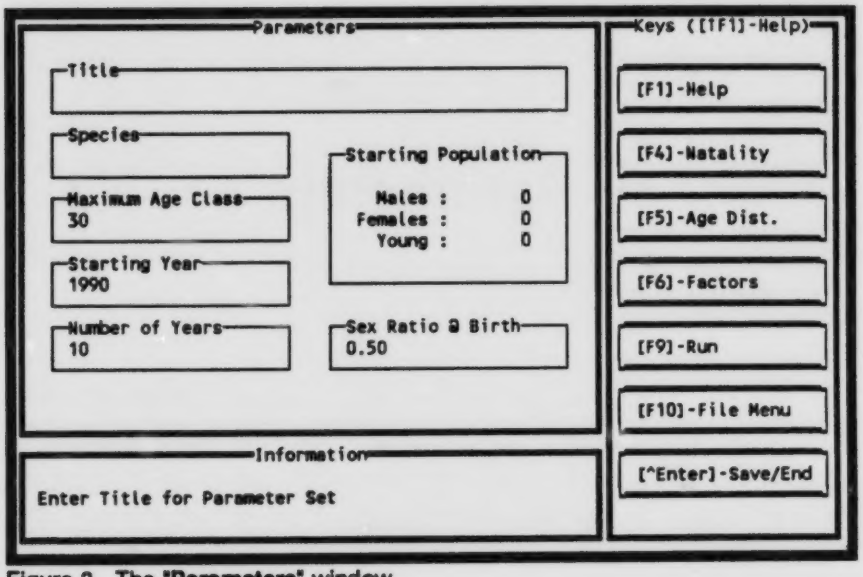

Figure 3. The **"Parameters"** window.

The following section contains a description of each field in the **"Parameters"** window and what information is expected in each field.

Fields

Title...

The title is a descriptive field used to identify the current Parameter. This field prints on all reports.

Species...

This field is also a descriptive field to allow the user a quick way to identify the current Parameter set. It has no bearing on the algorithms used during the simulations.

Maximum Age Class...

This field should contain the maximum attainable age class of the species being modelled. During the simulation process an animal is assumed to perish when it reaches an age in excess of the number entered here. The number entered must be greater than 0 and less than or equal to 30. The default value is 30. If a number outside this range is entered an error window pops up on the screen to notify you of the mistake. The default value is 30.

Starting Year...

Indicate the starting year of your simulation. Tnis is included to make reports more readable. Any number between 0 and 9999 can be entered here, the default is the current calendar year. A number outside of this range causes an error window to pop up notifying you of the mistake. The default is the current calendar year.

Number of Years...

Indicate the number of years to be simulated. The simulation starts just prior to reproduction in the **"Starting Year"** and continues for **"Number of Years"**. If, as in Figure 3, you enter 1990 as the **"Starting Year"** and 10 in this field, the last year to be completely simulated would be 1999. The number entered here must be greater than 0 and less than or equal to 10, the default is 10 years. A number outside of this range causes an error window to pop-up notifying you of the error. The default is 10 years.

Starting Population...

The three fields **"Males"**, **"Females"**, and **"Young"** indicate the number of animals in these age-sex classes just prior to reproduction in the **"Starting Year"**. The **"Males"** and **"Females"** fields are for adult animals (an animal is considered an adult on the first anniversary of its birth). The **"Young"** field is for young of the year only, these animals are separated into males and females according to the **"Sex Ratio @ Birth"** field (see below). These numbers can range from 0 to 999,999, the default is 0. If a number outside of this range is entered you are notified of the error.

You will also be required to enter the age-specific distributions of the **"Males"** and **"Females" before you can run a simulation**, this will be discussed in the **"Age Distribution"** section later in the manual.

Sex ratio @ Birth...

This field is used to divide young-of-the-year animals into males and females. The number should represent the proportion of total offspring that are males. For example, if there were 100 **"Young"** animals of which 48 young-of-the-year are males and 52 young-of-the-year are females, you would enter 0.48 here. This number can range from 0.00 to 1.00, the default is 0.50. As in other fields, if a number outside this range is entered you will get an error message.

Natality Rates [F4]

Pressing [F4] pops-up the **"Natality"** window (Figure 4). The number of age classes displayed in this window will be equal to the value entered in **"Maximum Age Class"** of the **"Parameters"** window. A maximum of 15 different age-classes are shown in the window at once. If more than 15 was entered in the **"Maximum Age Class"** field a "scroll-bar" will be present on the left border of the **"Natality"** window indicating more information can be accessed by scrolling through the window using the [Up] and [Down] keys.

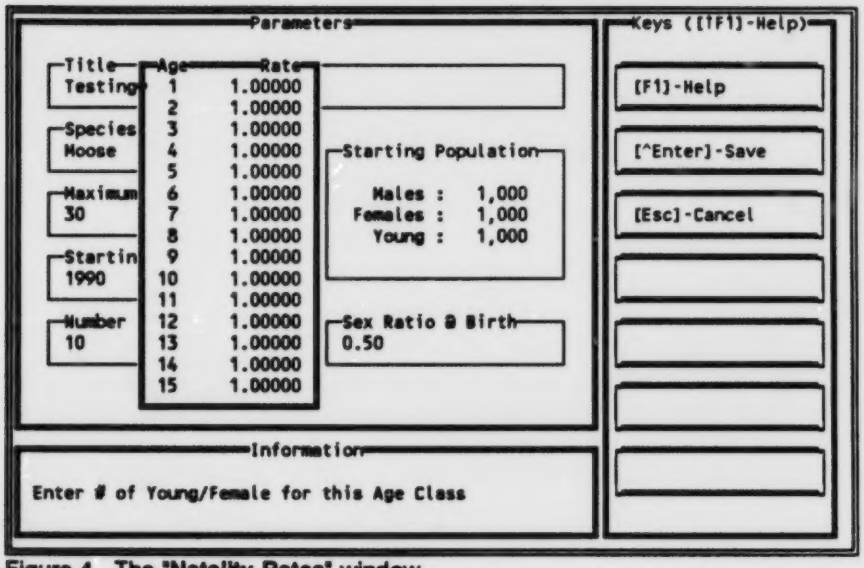

Figure 4. The **"Natality Rates"** window.

The numbers entered here represent the average number of young produced by each female in each age class. For example, entering a 1.5 in the field adjacent to age-class 5 would cause the model to produce 1.5 young for each female 5 years of age each time reproduction occurs. The default value for each age is 0.00000 on start-up.

Once you have specified the age-specific natality rates for the population being simulated, press [Ctrl-Enter] to return to the **"Parameters"** window and save the changes. Pressing [Enter] at the last field also saves the changes and returns you to the **"Parameters"** window. If you make a mistake while editing the age-specific natality rates press [Esc] which cancels all changes to the table made since you accessed it using [F4].

Age Distribution [F5]

Pressing [F5] while in the **"Parameters"** window will bring up the **"Age Distribution"** window (Figure 5). As in the **"Natality"** window, the number of age classes displayed is linked to the value entered in the **"Maximum Age Class"** field of the **"Parameters"** window. If you specified more than 15 for this field you may scroll through the window using the [Up] and [Down] keys.

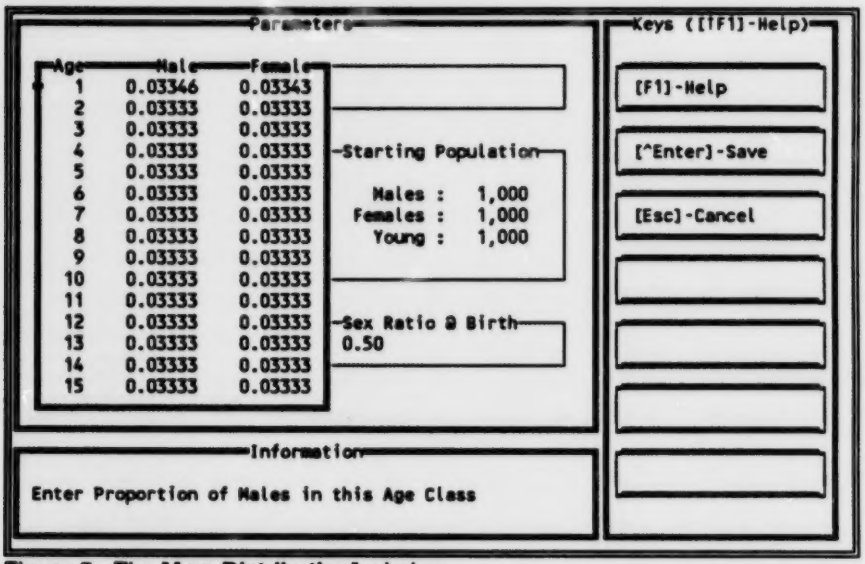

Figure 5. The **"Age Distribution"** window.

The **"Age Distribution"** window consists of two columns of fields: **"Males"** and **"Females"**. Each table entry represents the proportion of the animals specified in the **"Starting Population"** box of the **"Parameters"** window. This, perhaps, can best be explained by an example: If you had entered 100 in the **"Females"** field for the **"Starting Population"** and 0.05000 in the **"Females"** column of the **"Age Distribution"** window across from age 14 then the model would assign 5 animals (100 * 0.05000 = 5) to be females of age 14. The default value for these fields is 0.00000 for each value.

The **"Male"** and **"Female"** columns should each add to 1.00000. If a column adds to less than 1.00000 then the actual starting population will be less than that specified in the **"Parameters"** window. If a column adds to more than 1.00000 then the inverse will occur and you would be starting with more animals than specified in the **"Parameters"** window.

You can exit form this window at any time using [Ctrl-Enter] to save your changes or [Esc] to cancel the changes made. Pressing [Enter] on the last field in the window is synonymous with pressing [Ctrl-Enter].

When you attempt to exit the **"Age Distribution"** window and save the changes *Analogy* checks to see if each column adds to a value between 0.999995 and 1.000005. If one or both columns sum to a value outside this range you are shown the sums and asked to verify exiting the **"Age Distribution"** window using these values.

III The Factors

Factors define the extrinsic influences that affect the population, when they occur during the reproductive cycle and their severity. In most modelling applications these factors would be sources of mortality such as wolf kill or sport hunting, but, it is possible to add animals to the population using these factors if, for instance, you wanted to specify immigration as a Factor. You may create up to 25 different Factors that affect the population, and each can be turned on or off for any particular year (refer to **"The Years Fields"**).

This chapter explains how to insert, delete, copy and rearrange Factors in the Factors list. The next chapter describes the modifying of a single Factor in the Factor list.

The Factors List

The Factor system can be accessed by pressing [F6] while in the **"Parameters"** window. Figure 6 shows the screen after the **"Factors"** window has been accessed and an example list of Factors.

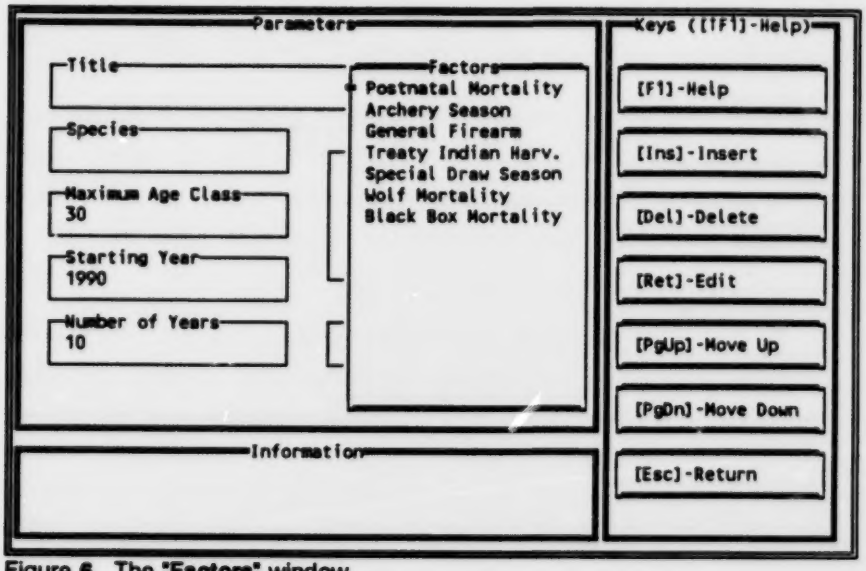

Figure 6. The **"Factors"** window.

The **"Factors"** window displays a list of the factors currently defined in the active Parameter set. By default the list is empty. It is very **important** that you remember three points when creating and modifying lists of Factors : 1) reproduction occurs before any factor in the list (i.e. the annual cycle runs from reproduction to reproduction); 2) each factor is applied to the population in the order it appears in the Factor list; and 3) each factor is applied independent of any other factors. For example, a year of simulation for the Factor list in Figure 6 would be processed in the following manner :

1. Reproduction takes place.
2. Postnatal Mortality is applied to the population.
3. The "Archery Season" factor is applied.

4. The "General Firearm" factor is applied.
5. The "Treaty Indian Harv." factor is applied.
6. The "Special Draw Season" factor is applied.
7. The "Wolf Mortality" factor is applied.
8. The "Black-box Mortality" factor is applied.

If the "Wolf Mortality" factor is specified as a percentage of the total population (this will be discussed in detail later on in the manual), the number used in the calculations is the population after the preceding 5 factors have been applied, not the population before reproduction. The rest of this section describes how to modify the list of Factors.

The Keys

Inserting Factors [Ins]...

Since you start with an empty Factors list the first thing you will want to do is add a Factor. To do this simply press [Ins] (the insert key). Another window will pop-up titled **"Factor"**. The section titled **Modifying Factors** will describe how to edit and manipulate individual Factors. If you have already defined 25 Factors, a message pops-up to indicate that the maximum number of Factors has been reached.

Deleting Factors [Del]...

To delete the highlighted Factor in the list press [Del] (the delete key on your keyboard). A message will pop-up asking you to verify the deletion. If you really want to delete the factor press [Enter] otherwise press [Esc]. Once a factor has been deleted it is gone forever unless you have saved your Parameter set on disk. (see Chapter V).

Editing Factors [Enter]...

To edit a particular Factor just highlight it and press the [Enter] key. The **"Factor"** window will pop-up with the data for that Factor. The following section describes the **"Factor"** window and its use.

Moving Factors [PgUp]/[PgDn]...

Since the order in which the Factors occur in the list is critical, a method to move them around without re-entry has been included. Pressing [PgUp] will move the highlighted Factor up one position in the list, [PgDn] moves the highlighted Factor down one in the list.

Copying Factors [Ctrl-PgDn]...

To enter similar Factors into the list the ability to copy a factor has been included. [Ctrl-PgDn] inserts a new factor below the highlighted Factor and copies all information from the highlighted Factor into the newly created Factor. This cannot be accomplished if the number of factors in the list is 25 because there is no room to insert the copy.

The next chapter describes how to modify an individual Factor once [Ins] or [Enter] has been pressed.

IV Modifying A Factor

If you have used the [Ins] or [Enter] keys to insert or modify a Factor, a window pops-up entitled **"Factor"** (Figure 7). This window is where you specify the name of the Factor, how it affects the population and when. This chapter describes each field of the **"Factor"** window and the process of entering **"Weights"** for each Factor.

The Fields

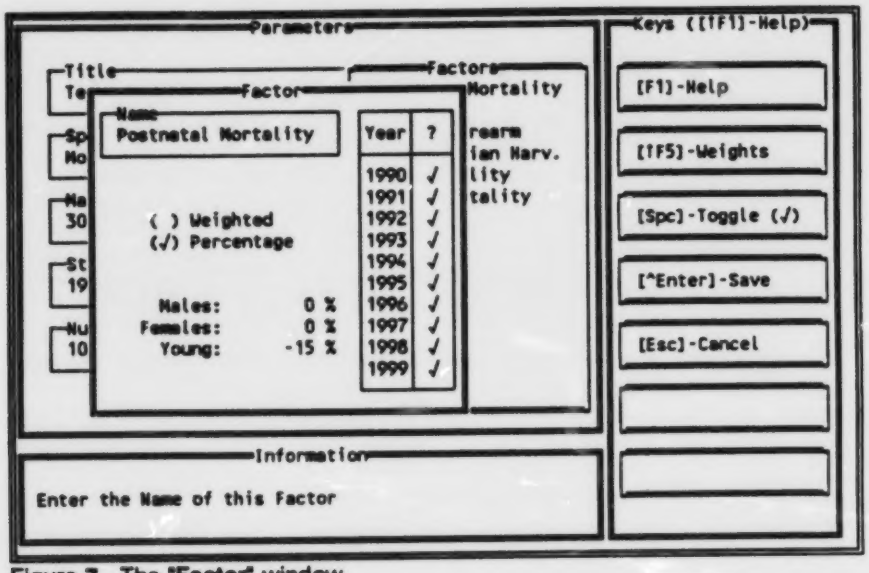

Figure 7. The "Factor" window.

Name...

Enter a descriptive name for the Factor being created or modified. This name will be printed with the results of the simulation. Although duplicate names are allowed, you should refrain from using them as it makes the results difficult to interpret.

If you are inputting a new Factor you are not allowed to leave the "Name" field until you have entered something. You cannot leave this field blank, you must supply a value.

Weighted...

This field is a checked field, that is, it can only be toggled on or off. A check-mark (represented by a √ symbol) indicates that the option is on, if there is no check-mark the option is off. The [Space Bar] is used to toggle between on and off. The default state is on.

If **"Weighted"** is checked the animals to be removed (or added) are done so according to a table of relative vulnerabilities. If **"Weighted"** is not checked the model assumes that all animals have an equal vulnerability to the Factor and are removed (or added) accordingly. If **"Weighted"** is checked, you will have to input the relative vulnerabilities within each sex-class, the section entitled **"Weights [↑F5]"** describes how you do this (see page 33).

Percentage...

This is another check-mark field. If **"Percentage"** is checked the numbers specified in the **"Males"**, **"Females"** and **"Young"** fields are assumed to be the percentage of total animals affected. If **"Percentage"** is toggled off (no check-mark) the numbers entered in the **"Males"**, **"Females"** and **"Young"** fields are taken to represent an absolute number of animals. For example, if there was a value of -20 in the **"Females"** field and **"Percentage"** was checked, this factor would remove 20% of the females in the population. If **"Percentage"** was not checked then this Factor would remove 20 females from the population.

While you toggle this option using the [Space Bar] you will notice "%" signs appearing and disappearing next to the **"Males"**, **"Females"** and **"Young"** fields. The default state is on.

Males, Females and Young...

This is where you specify how many (or what percent) of animals are affected by this Factor. The numbers can range between -99,999 and 999,999, the default value is 0. A negative number in one of these fields indicates that the Factor is a source of mortality, a positive number indicates the Factor represents an addition to the population. It is completely valid to enter -250 in a field while **"Percentage"** is checked indicating that 250% of the population is lost to this Factor. If this factor is applied, the number of animals in that segment of the population would become

0 since there cannot be a negative number of animals in a population.

The Years Fields...

The box within the **"Factor"** window with the column headings **"Year"** and **"?"** are where you specify which years the Factor is applied to the population. These fields are checked fields and are toggled on and off with the [Space Bar]. If a year has a check mark next to it, the Factor is applied in that year of the simulation. If there is no check mark the factor is ignored during that year. By default the factor is applied for all years of the simulation (i.e. all years are checked).

Exiting...

Pressing [Ctrl-Enter] at any time will exit out of the **"Factor"** window and save the changes you made to the Factor. If you want to abort the changes made press [Esc]. Pressing [Enter] on the last year in the **"Years"** box is synonymous with pressing [Ctrl-Enter].

Weights [↑F5]

If the **"Weighted"** field of the **"Factor"** window is checked you will want to specify the age-specific vulnerability of the **"Males"** and **"Females"** segments of the population being modelled. You can do this by pressing [Shift-F5] while you are anywhere within the **"Factor"** window. Figure 8 shows the **"Weight"** window screen.

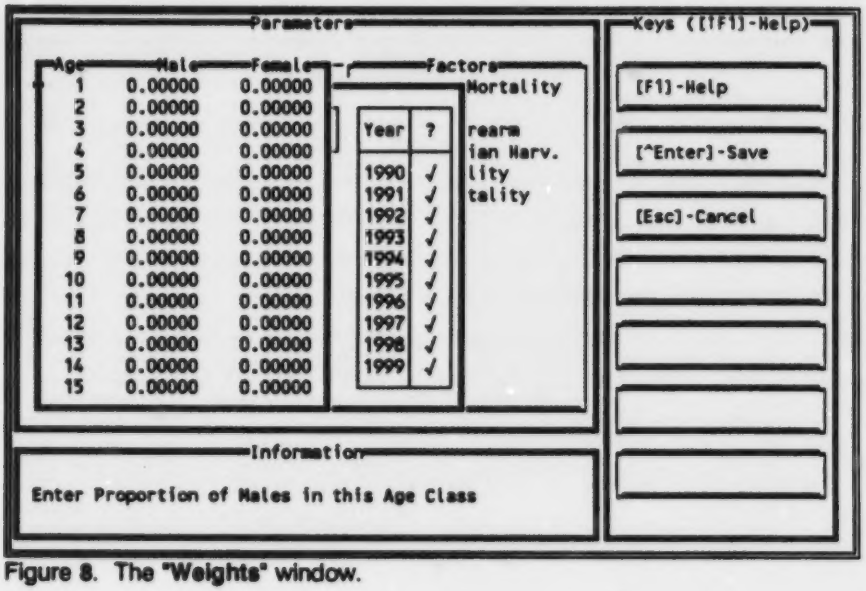

Figure 8. The **"Weights"** window.

The **"Weight"** window contains two columns of fields, **"Males"** and **"Females"**. These fields are similar in function to the **"Males"** and **"Females"** columns in the **"Age Distribution"** window. The numbers (or percentages) entered in the **"Males"** and **"Females"** fields of the **"Factor"** window are distributed according to these weights. For example, if the **"Males"** field in the **"Factors"** window had -45 (not a percentage) and you entered 0.03400 in the **"Males"** column across from age 12 then there would be 1.53 twelve year old males (-45 * 0.03400 = -1.53) removed from the population each time the factor was applied. If, instead, the **"Males"** field

was -45% (i.e. the percentage field was checked), and there was 200 adult **"Males"** in the population then there would be 3.06 animals removed from the population ((-45/100) * 200 * 0.03400 = -3.06).

To exit from the **"Weight"** window and save the changes made in it press [Ctrl-Enter]. If you do not want the changes you made to be saved simply press [Esc].

V The File Menu

Before running the model it is a good idea to save your Parameter set to disk. The file maintenance options in *Analogy* allow you to save your Parameter sets to disk for use in subsequent modelling sessions. It also provides options to load Parameter sets, load only the Factors from a Parameter set, clear the current Parameter set, erase Parameter sets and set output options. This chapter will discuss each item in the **"File Menu"** in more detail.

You can access the **"File Menu"** (Figure 9) by pressing [F10] while in the **"Parameters"** window.

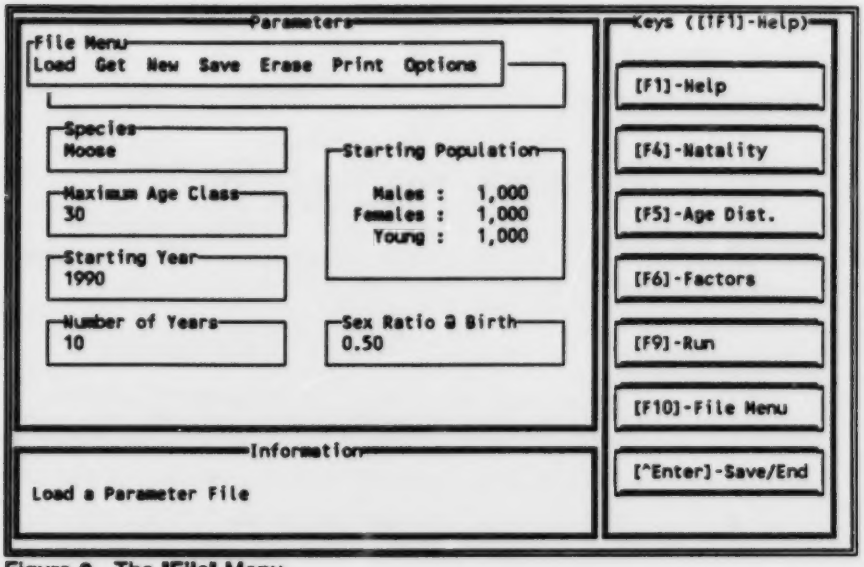

Figure 9. The **"File"** Menu.

As you can see the **"Keys"** window does not change when you access the menu. The only keys you have to use are the cursor keys to navigate through the menu and the [Enter] key to select the menu option you want. The [Esc] key returns you to the **"Parameters"** window. This chapter describes the options available through the **"File Menu"**.

File Names

All Parameter Files in *Analogy* have the extension *.PAR. When loading and saving Parameter files this extension is supplied automatically. Other extensions generate an error message to the screen.

Load

You can load a Parameter set from the disk by choosing **"Load"** from the **"File Menu"**. You can specify a DOS-style mask (for example *.PAR) to get a listing of file choices or you can load a specific file simply by typing in the name of the file you wish to retrieve (for example TEST.PAR). When entering file names the extension is optional (TEST.PAR is the same as entering TEST).

If the file name or directory you enter does not exist an error window pops-up on the screen indicating the problem, press [Esc] when you have finished reading the message.

Get

This option allows you to retrieve only the **"Factors"** from a specified Parameter file. The process for loading **"Factors"** is identical as that for loading an entire Parameter set. The **"Factors"** from the specified file overwrite the current **"Factors"**.

If the **"Maximum Age Class"** of the current Parameter set does not match the Parameter set file, you are warned and asked to confirm the loading of the **"Factors"** from the file.

New

Selecting **"New"** from the **"File Menu"** clears all of the **"Parameters"** and **"Factors"** currently in memory. A warning box appears on the screen asking you to verify clearing all of the **"Parameters"**. If you really want to do this press [Enter] otherwise press [Esc].

Save

The **"Save"** option allows you to save the existing Parameter set to a disk file. All Parameters, Factors and output options are saved with the file. When you select **"Save"** a window pops-up and you are prompted to enter a file name. If you do not include the .PAR extension it is added for you. If a file already exists of the same name you are asked to verify overwriting it with the new file.

Erase

The **"Erase"** option allows you to permanently erase selected Parameter files on the disk. The process for specifying a Factor to erase is similar to that of loading a Parameter set. You are asked to verify the deletion before it is actually done.

Print

This option prints the current Parameter set on the printer. This is the only way to get a hard copy of the Parameter set, they are not printed with the simulation results.

If the printer is not ready an error window pops-up and you are asked to try again.

Options

Selecting **"Options"** from the **"File Menu"** pulls down a menu of output options (see Figure 10).

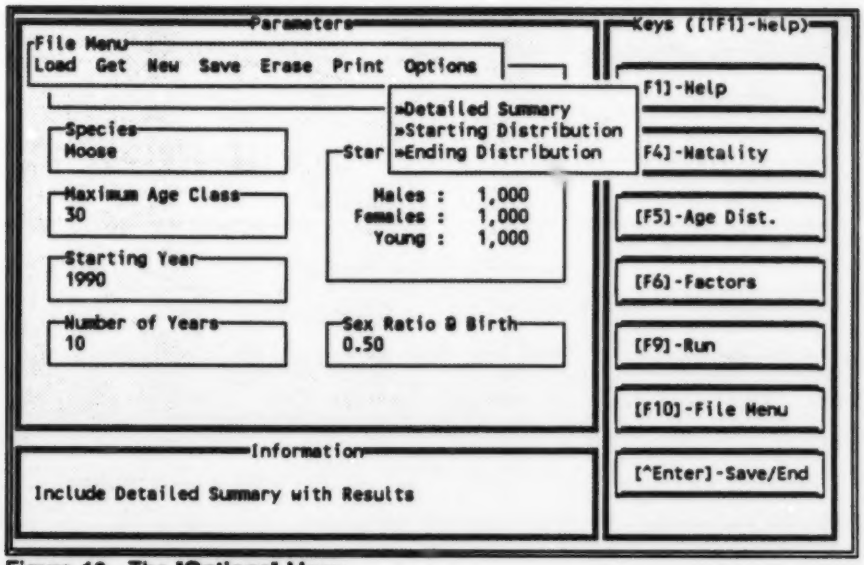

Figure 10. The **"Options"** Menu.

This menu contains three choices: **"Detailed Summary"**, **"Starting Distribution"** and **"Ending Distribution"**. Selecting and de-selecting these options determine what will be included in the results of the simulation. An option is selected if it has a "»" to the left of it. You may select and de-select by pressing the [Enter] key while the option is highlighted.

Selecting **"Detailed Summary"** causes a detailed print out of what occurred during each year of the simulation, it lists the starting population and the number of animals in each segment of the population after each **"Factor"** has been applied.

Selecting **"Starting Distribution"** and/or **"Ending Distribution"** causes the age-specific distributions for the population to be printed for the beginning and/or end of each year of the simulation.

Exiting The Menu

You may return to the **"Parameters"** window at any time by pressing the [Esc] key while on a menu item.

VI Running

Well, now that you have specified all of the population Parameters and input a list of Factors, it's time to actually run the simulation. This chapter describes what will be displayed when you run the model and how to navigate through the results when the simulation has completed.

When you press [F9] to run the model, *Analogy* first distributes the **"Starting Population"** according to the weights specified in the **"Age Distribution"** window. It then checks to see if the **"Males"** or **"Females"** segments of the population are zero. If they are, the **"Run"** is aborted, otherwise you will see a window pop-up displaying the progress of the simulation (see Figure 11).

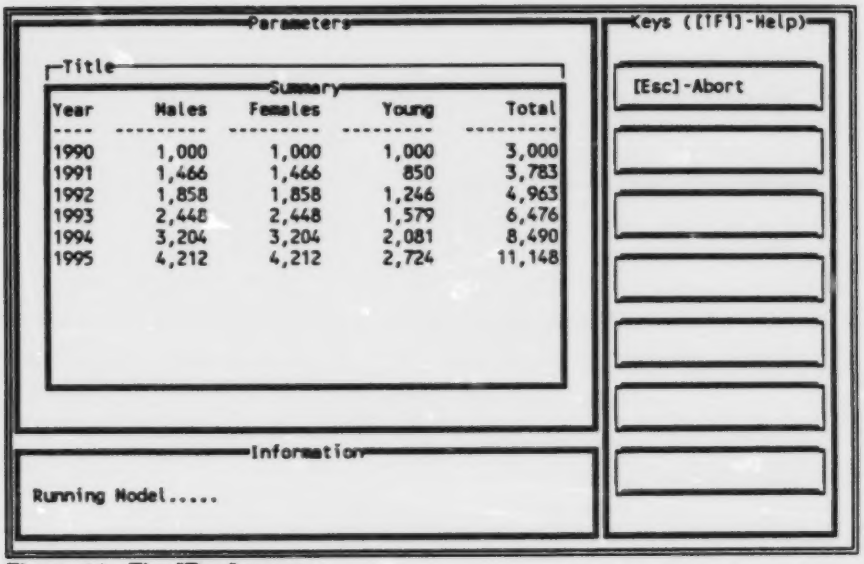

Figure 11. The **"Run"** screen.

As displayed in the **"Keys"** window, the only option you have while the model is running is **"Abort"**. This stops the simulation and takes you to the results windows.

If, at any time during the simulation, the number of **"Males"** or **"Females"** reaches zero or exceeds 1,000,000 the simulation is aborted and you are taken to the results windows.

The results of the model are displayed in two different windows, the **"Summary"** window and the **"Summary of ????"** window (the ???? represents the year) which is accessed by pressing [Space Bar] or [Tab].

The **"Summary"** window shows the population at the beginning of each year (see Figure 12). The summary window can be moved around using the **"Window re-Size"** key ([F2]).

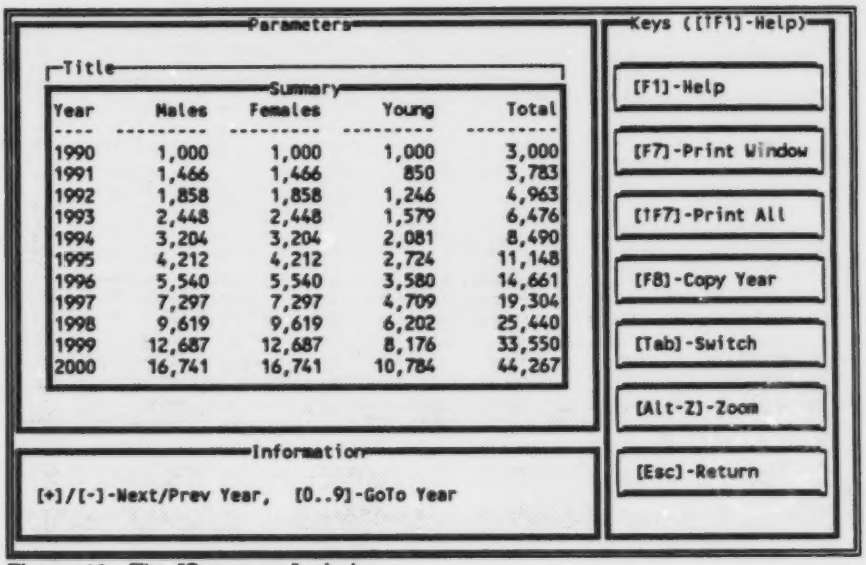

Figure 12. The **"Summary"** window.

The **"Summary of ????"** window contains detailed information about each year of the simulation depending on which **"Options"** were set. Figure 13 shows the **"Summary of ????"** window.

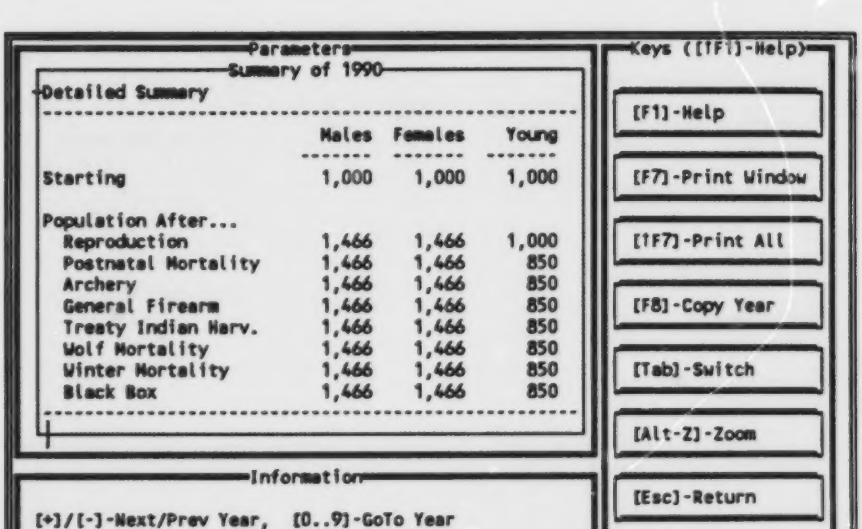

Figure 13. The **"Summary of ????"** window.

Figure 14 shows an expanded view of a **"Summary of ????"** window to illustrate all of the information available in this window assuming all output options were chosen in the **"Options"** menu.

The columns labelled **"Males"**, **"Females"**, **"Young"** and **"Total"** contain the number of adult males, adult females, young-of-the-year and totals respectively at the start of the year and after each Factor has been applied. The columns **"M:100F"** and **"Y:100F"** contain the number of males per 100 females and the number of young per 100 females respectively at the start of the year and after each Factor has been applied.

The Starting Distribution and End Distribution tables show the number of adult animals in each age class (rounded down).

Summary of 1990

Detailed Summary — Year : 1990

	Males	Females	Young	Total	M:100F	Y:100F
Starting	1,000	1,000	1,000	3,000	100.0	100.0
Population After...						
Reproduction	1,466	1,466	1,000	3,933	100.0	68.1
Postnatal Mortality	1,466	1,466	850	3,783	100.0	57.9
Archery	1,466	1,466	850	3,783	100.0	57.9
General Firearm	1,466	1,466	850	3,783	100.0	57.9
Treaty Indian Harv.	1,466	1,466	850	3,783	100.0	57.9
Wolf Mortality	1,466	1,466	850	3,783	100.0	57.9
Winter Mortality	1,466	1,466	850	3,783	100.0	57.9
Black Box	1,466	1,466	850	3,783	100.0	57.9

Starting Distribution — Year : 1990

Age	Males	Females	Age	Males	Females	Age	Males	Females
1	33	33	11	33	33	21	33	33
2	33	33	12	33	33	22	33	33
3	33	33	13	33	33	23	33	33
4	33	33	14	33	33	24	33	33
5	33	33	15	33	33	25	33	33
6	33	33	16	33	33	26	33	33
7	33	33	17	33	33	27	33	33
8	33	33	18	33	33	28	33	33
9	33	33	19	33	33	29	33	33
10	33	33	20	33	33	30	33	33

Year End Distribution — Year : 1990

Age	Males	Females	Age	Males	Females	Age	Males	Females
1	500	500	11	33	33	21	33	33
2	33	33	12	33	33	22	33	33
3	33	33	13	33	33	23	33	33
4	33	33	14	33	33	24	33	33
5	33	33	15	33	33	25	33	33
6	33	33	16	33	33	26	33	33
7	33	33	17	33	33	27	33	33
8	33	33	18	33	33	28	33	33
9	33	33	19	33	33	29	33	33
10	33	33	20	33	33	30	33	33

Figure 14. Example results.

Viewing The Results

There are a number of special keys that can be used to view the results of a simulation. Each key is described below.

Navigating Between Windows...

The [Tab] key and/or the [Space] bar can be used to switch between the two results windows. Some of the other keys used to access and manipulate the **"Summary of ????"** window also cause that window to be displayed.

Navigating Within Windows...

The following keys allow you to view the current window and view parts of the window not currently in view:

[↑], [↓], [←] and [→]	Use these keys to scroll through the window one line at a time. These keys only work if the window has scroll-bars on the left and/or bottom borders.
[PgUp] and [PgDn]	Scroll the window up or down one screen at a time.
[Ctrl-←] and [Ctrl-→]	Scroll the window left or right one screen at a time.
[Home] and [End]	Go to the top or bottom of the window.
[Ctrl-Home] and [Ctrl-End]	Go to the left most or right most edge of the window.
[Alt-Z]	This key makes the **"Summary of ????"** window as large as possible. If the window is already zoomed the window is re-sized back to its original size.

Navigating Between Years...

The following keys let you navigate between different years in the **"Summary of ????"** window:

[+], [Ctrl-PgDn], [Enter]	View the next year of data. If you are currently on the last year of the simulation you are taken back to the first year.
[-] or [Ctrl-PgUp]	View the previous year of data. If you are currently viewing the first year of the simulation you are taken to the last year.
[0]..[9]	These numeric keys take you to the associated year of the simulation. For example, pressing [3] will take you to the **"Summary of ????"** window for the 3rd year of the simulation.

Printing...

The following keys handle the printing of results to the printer:

[F7]	Prints the current window.
[Shift-F7]	Prints all years of the simulation.

Copying a Year...

The [F8] key can be used to copy the population information at the end of the current year of the **"Summary of ????"** window back into the Parameters. The following data in the Parameter set will be updated: the **"Age Distribution"** will be updated with the **"Year End Distribution"**; the **"Starting Population"** will be updated with the population values from the end of the current year; and the **"Starting Year"** will be updated with the current results year plus one. When you press [F8] you are asked to verify the updating of the Parameters, press [Enter] to copy or [Esc] to cancel the copying. This feature will be discussed in more detail in the **"Tips and Techniques"** chapter.

Note: The current parameters are overwritten when copying the population information so make sure you have saved your Parameter set to a file before doing this. The activity status of your "Factors" remain consistent with the old Parameter set (ie. if a Factor was active for the first 3 years of the simulation it will still be active for the first 3 years even though the actual "Starting Year" has changed).

Exiting the Results...

You may press [Esc] at any time while viewing the results to return to the **"Parameters"** window. You will be asked to verify your request to exit. To bypass this verification requirement you may press [Ctrl-Enter] instead of [Esc]. Once you have exited the results you must run the simulation again to view them.

VII Tips and Techniques

This chapter will discuss and give examples of some of the more advanced features of *Analogy*. In particular, the following topics will be discussed: the effective use of **"Factors"** in doing what-if analysis; sensitivity analysis; and techniques for simulating more than 10 years.

Sensitivity Analysis

It is a forgone conclusion that all of the Parameters and Factors entered into *Analogy* will be, at best, estimates of the real world. *Analogy* will be relatively insensitive to slight errors in some Parameters and highly sensitive to inaccuracies in others. Due to the dynamic nature of *Analogy* this "sensitivity", for the most part, will be unique to each Parameter set. This section describes the process of determining the sensitivity of the model to a slight change in one Parameter (namely the **"Sex Ratio @ Birth"** Parameter). For the purposes of this example we will assume the following about the population:

- there is no mortality.
- each female produces 1 offspring each year of adult life.
- no animal lives beyond age 5.
- there are 100 males, 100 females and 100 young in the population.
- there are an equal number of animals in each age class at the beginning of the simulation (ie. 20 males and 20 females of each age).
- the simulation will be for 10 years starting in the year 2000.
- the sex ratio at birth is 0.50.

With this information we can input the Parameters for the simulation. If you have not already done so, start *Analogy*. If you are already working in *Analogy* clear the existing Parameters by choosing **"New"** from the **"File Menu"**, making sure you save any important work first. Fill in the **"Parameters"** window so it resembles Figure 15.

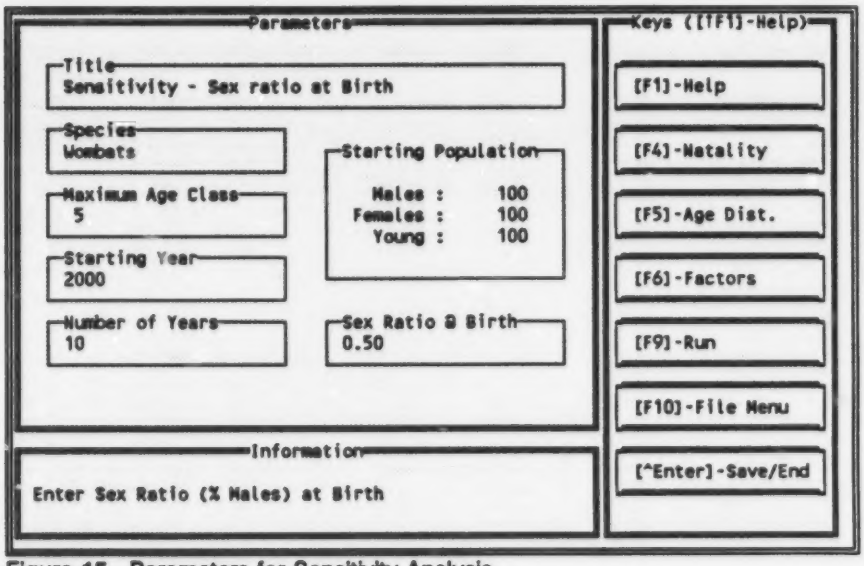

Figure 15. Parameters for Sensitivity Analysis.

Next press [F4] and enter the age-specific natality rates. Because we entered 5 for the **"Maximum Age Class"** you are only allowed to enter the reproductive rates for females from age 1 to 5. Enter 1.00000 for each of the five age classes. Your screen should resemble Figure 16 before you exit the window with [Ctrl-Enter] and return to the **"Parameters"** window.

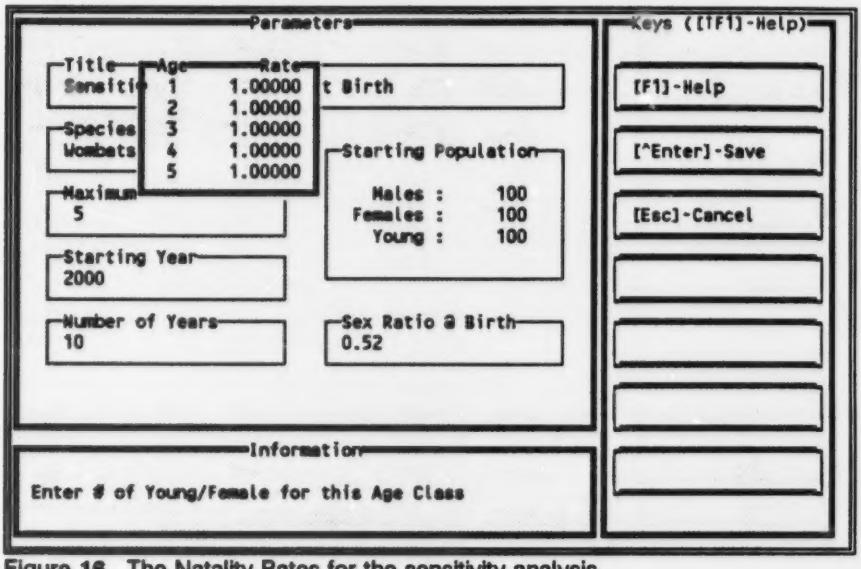

Figure 16. The Natality Rates for the sensitivity analysis.

Now press [F5] to enter the **"Age Distribution"**. For this example we assumed an equal distribution, this results in 0.20000 being entered in each age-class of the **"Age Distribution"** (5 age classes / 100 males = 0.20000), the same for females. Your screen should look like Figure 17 before you use [Ctrl-Enter] to save the **"Age Distribution"**.

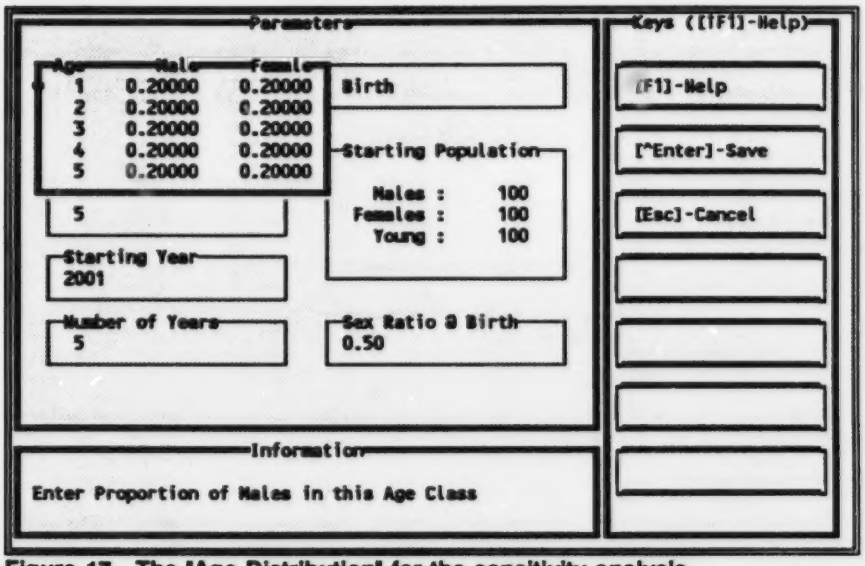

Figure 17. The "Age Distribution" for the sensitivity analysis.

You should now be back at the **"Parameters"** window. If you are not, get there now by pressing [Ctrl-Enter]. Save the Parameter set to a file now, press [F10] for the **"File Menu"** and select **"Save"**. Type in WOMBAT.PAR and press [Enter]. This Parameter set will be used in later examples.

Press [F9] to run the model, when it is complete your screen should look like Figure 18.

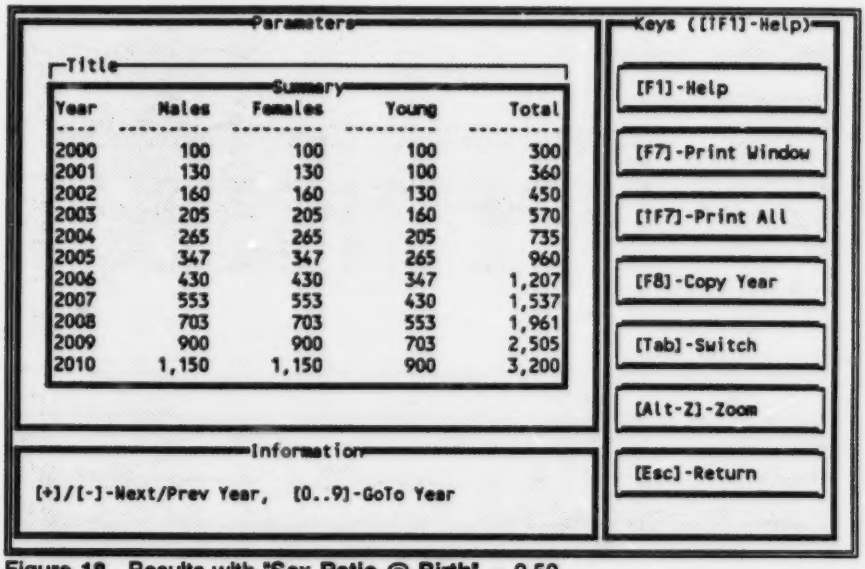

Figure 18. Results with **"Sex Ratio @ Birth"** = 0.50.

You may print this window by pressing [F7]. Now exit the results by pressing [Ctrl-Enter]. Run the model two more times using **"Sex Ratio @ Birth"** = 0.52 for the first time and **"Sex Ratio @ Birth"** = 0.48 the next time. Your results should be the same as those in Figures 19 and 20.

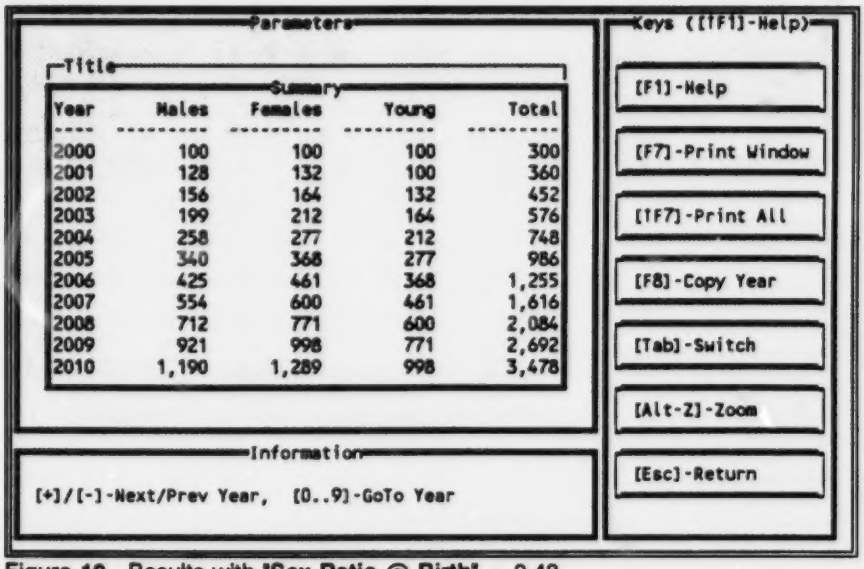

Figure 19. Results with "Sex Ratio @ Birth" = 0.48.

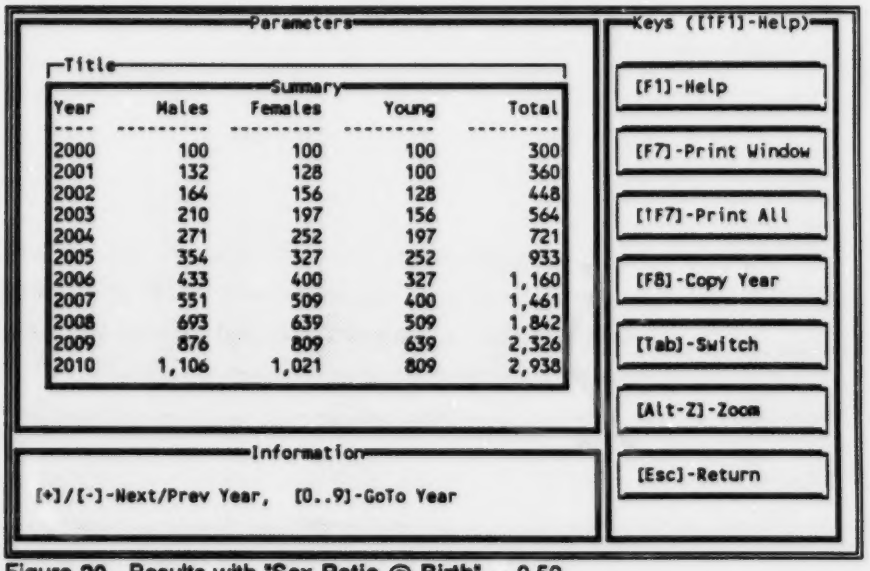

Figure 20. Results with "Sex Ratio @ Birth" = 0.52.

The final results of each run are summarized in Figure 21. You will notice that changing the **"Sex Ratio @ Birth"** by 4% results in an -8% change in the final population at the end of 10 years of simulation. Also of interest is the fact that changing the **"Sex Ratio @ Birth"** by -4% results in a 9% change in the resulting population. Changing the Parameter by the same magnitude in different directions did not result in a fixed change of the population.

Sex Ratio @ Birth	% Change	Total Population	% Change
0.50		3200	
0.52	4%	2938	-8%
0.48	-4%	3478	9%

Figure 21. Sensitivity analysis results.

You will also note, by examining Figures 18, 19 and 20, that the effect is not fixed over the duration of the simulation (i.e. at year 5 of the simulation the relative change is less than at year 10).

Try specifying the **"Maximum Age Class"** as 10 years and do the same analysis again, you may be surprised at the results.

You are encouraged to study the effect of slight changes in one or more Parameters. You will gain considerable insight to which Parameters your particular modelling exercises are sensitive to, and therefore which Parameters you should strive for accuracy in.

What-if Analysis

Frequently of interest to wildlife managers is the what-if scenario. "What if I increased the Quota from 50 to 100 in two years ?", "What could happen if we had a severe winter next year ?", etc.. This section will illustrate some features of *Analogy* that aid in these types of queries. Some of the features built in to *Analogy* are specifically for evaluating what-if scenarios quickly and easily. This section will discuss in more detail the copying of Factors and the manipulation of their Activity status. Let's use the first question above as an example.

If you saved the Parameters from the **"Sensitivity Analysis"** section to a file, load it up now. If not, clear the existing Parameters (see **"New"** in the **"File Menu"** chapter) and input the Parameters as described in the **"Sensitivity Analysis"** section.

Note: ensure that the **"Sex Ratio @ Birth"** value is 0.50.

Change the **"Starting Year"** to 1990 for this exercise.

Enter a new Factor for this Parameter set. Press [F6] from the **"Parameters"** window, you should see an empty Factor list (Figure 22).

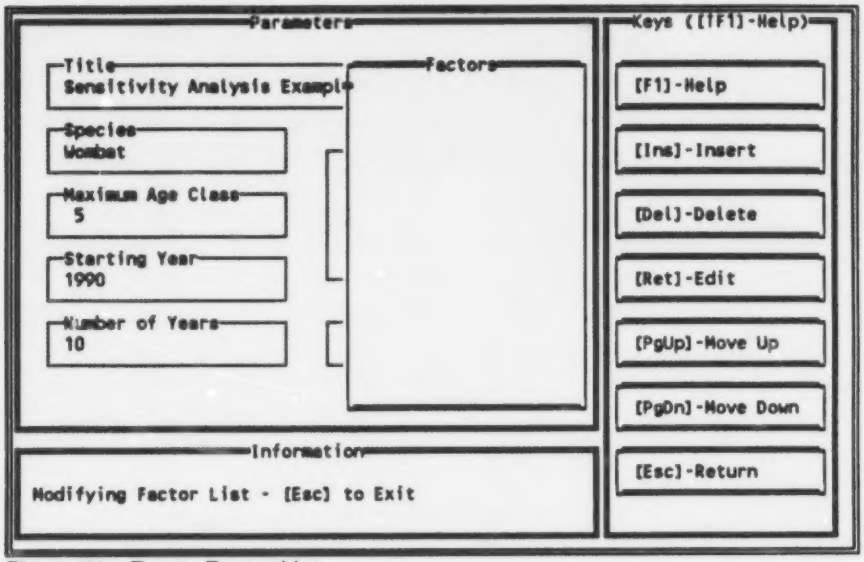

Figure 22. Empty Factor List.

Press the [Ins] key to insert a Factor. The "**Factor**" window should appear on the screen. Fill in the fields to resemble Figure 23.

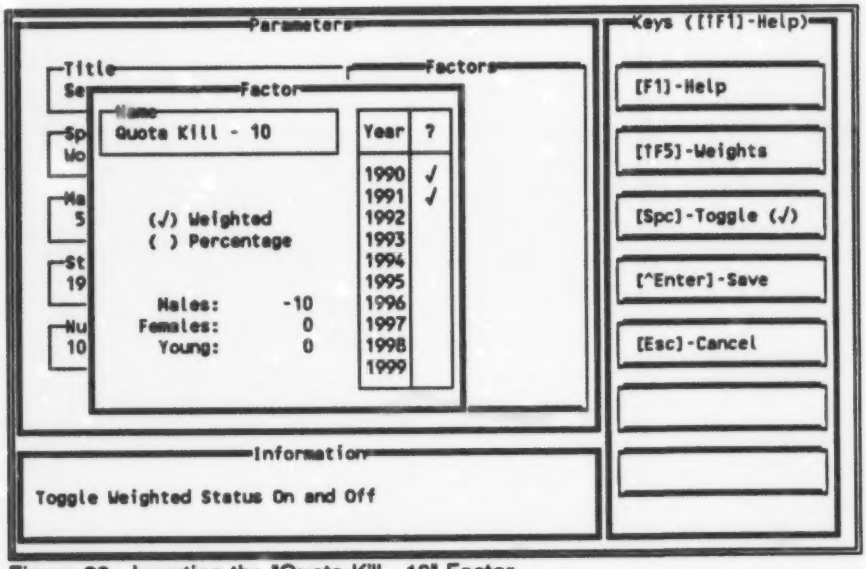

Figure 23. Inserting the "Quota Kill - 10" Factor.

Before you exit the "Factor" window press [↑F5] to bring up the "Weights" window. For this Factor we will assume that the younger an animal is the more vulnerable it will be to the Factor. Enter the weights as shown in Figure 24.

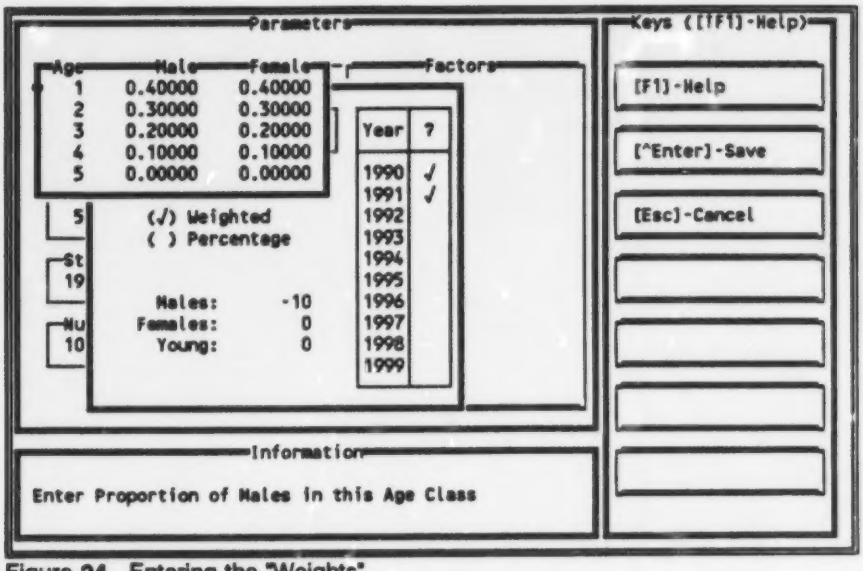

Figure 24. Entering the "Weights".

Press [Ctrl-Enter] to exit from the **"Weight"** window and press it again to exit from the **"Factor"** window. Now, with "Quota Kill - 10" highlighted in the **"Factors"** window press [Ctrl-PgDn] to create a copy of this Factor. Your screen should now resemble Figure 25.

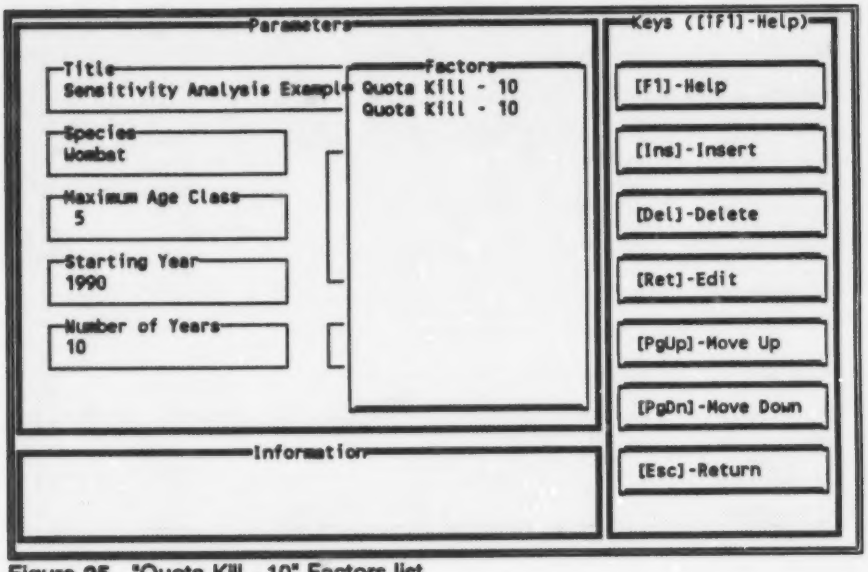

Figure 25. "Quota Kill - 10" Factors list.

Press [Enter] to edit the copy of the Factor and change the copy to resemble Figure 26. Once you have done this press [Ctrl-Enter] to save the altered copy. Your screen should now resemble Figure 27.

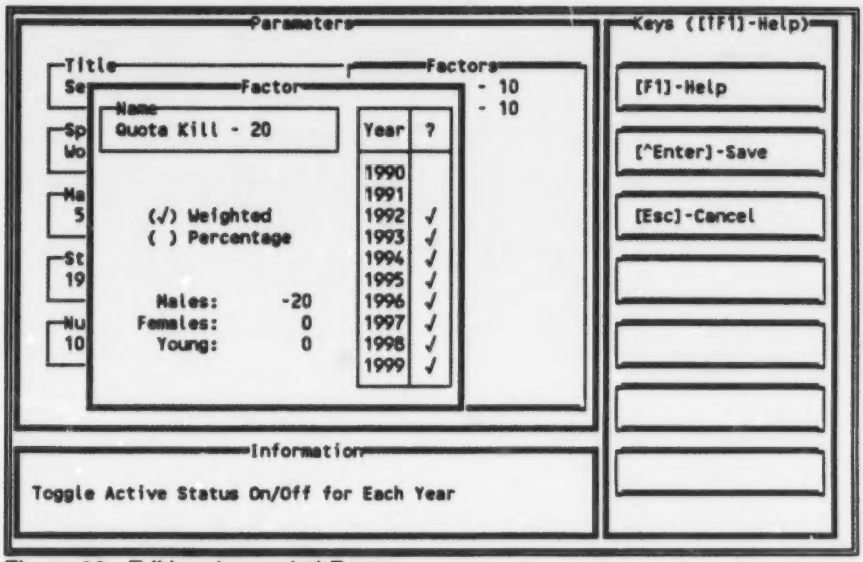

Figure 26. Editing the copied Factor.

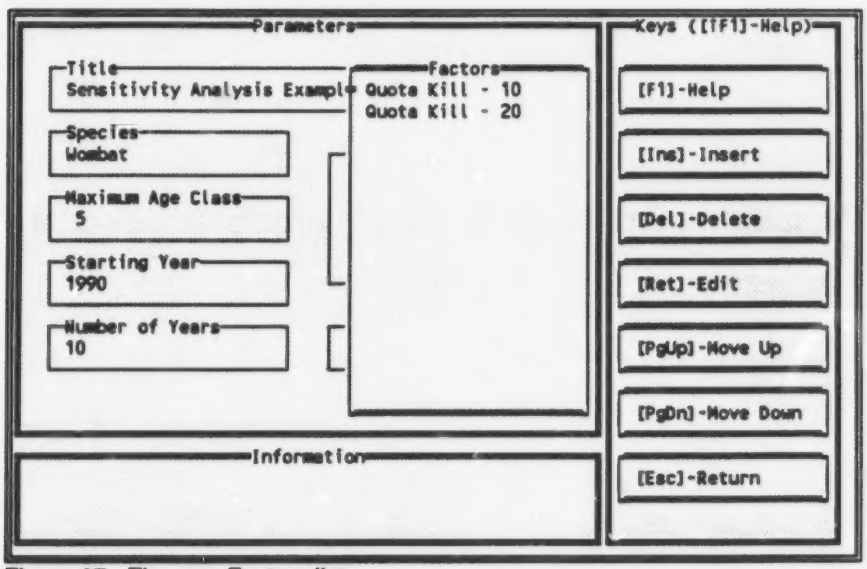

Figure 27. The new Factors list.

When you run the model with these Parameters, the first two years of simulation will take 10 animals from the population due to the "Quota Kill - 10" Factor. During the remaining years 20 animals will be removed due to the "Quota Kill - 20" Factor.

Try changing the Factors so the Quota doesn't change until the 5th year of the simulation and study the effect on the results.

As you can see, the use of the **"Copy Factor"** key ([Ctrl-PgDn]) can save time in creating almost identical Factors differing only in magnitude and the time they are active.

The second question posed in the introduction of this section, "What if I have a bad winter in 1997 ?", can be analyzed by creating a special Factor called "Bad Winter" and specifying the appropriate details of the Factor. You can have it active for one year of the simulation and turned off for the rest. Once the Factor is specified you can study what happens if you change the year it's active or what happens if you have it active for two or more years (not necessarily consecutive).

The specification and manipulation of Factors in *Analogy* was designed to be as flexible as possible, while still lending a degree of structure to the modelling exercise.

Simulating More than 10 Years

The **"Copy Results"** key has been included to allow you to continue simulations for more than 10 years. This section will describe how this is done in more detail.

The **"Copy Results"** key ([F8]) is only available when you are viewing the results. Refer to the **"Copying a Year"** section of the **"Running"** chapter (page 48) for more specific information about this key.

To simulate more than 10 years follow these steps :

1. Save your Parameter set to a file (see **"File Menu"**).
2. Run the simulation (see **"Run"**).
3. Print the **"Summary"** window ([F7]). Then press [Tab] to view the **"Summary of ????"** window and press [↑F7] to print all of the results. Note: this step is important because you cannot return to these results later.
4. View the **"Summary of ????"** window for the last year of the requested simulation.
5. Press [F8] to copy the population values from the end of the last year of the simulation back to the Parameters and press [Enter] to verify the copy.
6. Exit the results by pressing [Ctrl-Enter] or [Esc].
7. Check your Factors activity status' and modify them if required.
8. Press [F9] to run the model again.

The results from the second simulation will be a continuation of the first set of results. You could also use the **"Get"** option from the **"File Menu"** to load an entirely different set of Factors to use for the second half of the simulation.

VIII Conclusion

The intent of *Analogy* was to provide wildlife managers with a fast and flexible tool that would lend additional insights into managing wildlife populations. *Analogy* will not be all things to all people, but, hopefully it will help fill some pieces of the wildlife management puzzle.

If, while using this software, you encounter "bugs" please notify the author. Before contacting the author you should know the version of DOS you are using and the type of computer you are using. Any information you can provide about what you were doing prior to the problem and any diagnostic messages reported by the software or system should also be noted and relayed to the author.

Appendix I

Analogy uses one of four separate algorithms when applying **"Factors"** to the population being simulated. *Analogy* determines which algorithm to use based on the status of the **"Percentage"** and **"Weighted"** check-mark fields. This appendix lists these four equations and the equations used for reproduction.

Notation

i	Subscript indicating the age of an animal in years (ranges from 1 to **"Maximum Age Class"** - see page 15).
$T_{M,i}$	The number of males in the population of age i at time *t*.
$T_{F,i}$	The number of females in the population of age i at time *t*.
T_M	The total number of males in the population at time *t* (i.e. $\Sigma T_{M,i}$).
T_F	The total number of females in the population at time *t* (i.e. $\Sigma T_{F,i}$).
T_Y	The total number of young-of-the-year animals in the population at time *t*.
T_Y^*	The number of new young produced by adult females before graduation.
Q_M	The number (or percentage) of males to add or remove (as specified in **"Males"** field of the **"Factor"** window - see page 31).
Q_F	The number (or percentage) of females to add or remove (as specified in **"Females"** field of the **"Factor"** window - see page 31).
Q_Y	The number (or percentage) of young-of-the-year to add or remove (as specified in **"Young"** field of the **"Factor"** window - see page 31).
$W_{M,i}$	The weight input for the **"Factor"** for males of age i (as specified in the **"Males"** column of the **"Weight"** window - see page 33).
$W_{F,i}$	The weight input for the **"Factor"** for females of age i (as specified in the **"Males"** column of the **"Weight"** window - see page 33).
R_i	The natality rate for a female of age i (see **"Natality Rates"** - page 19).

Weighted On (✓) and Percentage On (✓)

$T_{M,i} = MAX((T_{M,i} + (T_M * (Q_M /100) * W_{M,i})), 0).$

$T_{F,i} = MAX((T_{F,i} + (T_F * (Q_F /100) * W_{F,i})), 0).$

$T_Y = MAX((T_Y + (T_Y * (Q_Y /100))), 0).$

Weighted On (✓) and Percentage Off ()

$T_{M,i} = MAX((T_{M,i} + (Q_M * W_{M,i})), 0).$

$T_{F,i} = MAX((T_{F,i} + (Q_F * W_{F,i})), 0).$

$T_Y = MAX((T_Y + Q_Y), 0) .$

Weighted Off ( ) and Percentage On (✓)

$T_{M,i} = MAX((T_{M,i} *(1 + (Q_M /100))), 0).$

$T_{F,i} = MAX((T_{F,i} *(1 + (Q_F /100))), 0).$

$T_Y = MAX((T_Y * (1 + Q_Y)), 0).$

Weighted Off ( ) and Percentage Off ()

$T_{M,i} = MAX((T_{M,i} * (1 + (Q_M /T_M))), 0).$

$T_{F,i} = MAX((T_{F,i} * (1 + (Q_F /T_F))), 0).$

$T_Y = MAX((T_Y + Q_Y), 0).$

Reproduction

Impregnation $T_Y^* = \Sigma(T_{F,i} * R_i),$ (1 <= i <= **"Maximum Age Class"**).

Graduation $T_{M,i} = T_{M,(i-1)}$ and $T_{F,i} = T_{F,(i-1)}$, (2 <= i <= **"Maximum Age Class"**), and

$T_{M,1} = T_Y$ * **"Sex Ratio @ Birth"** and $T_{F,1} = T_Y$ * (1 - **"Sex Ration @ Birth"**).

Birth $T_Y = T_Y^*$

Appendix II

This appendix contains the answer to some commonly asked questions that arise when using *Analogy*.

"Why, when I specify a Factor to remove a certain number of animals, the results indicate that none are removed by the Factor ?"

This is most likely the result of specifying the Factor as weighted and neglecting to enter the relative vulnerabilities of the population. See page 33.

"I have specified a factor to remove a certain number of animals from the population but it seems to add them instead, whats wrong ?"

Factors that remove animals from the population must be specified as negative numbers in the **Males**, **Females**, and **Young** fields of the **Factor** window. See page 31.

"How can I specify differential mortality between young-of-the-year males and young-of-the-year females ?"

You can't. The model assumes equal vulnerability of young-of-the-year animals in the population. You may approximate differential mortality by adjusting the **Sex ratio @ Birth** field of the **Parameters** window but you should beware of the possible side effects of doing so.

"I keep getting 'Memory Limits Exceeded' and 'Out of memory' errors, whats wrong ?"

Analogy was designed to work with computers with at least 256K of memory. If your computer has this you may have TSR's that are using too much memory. Try unloading all unnecessary memory resident programs.

"How come the number of Factors in my results doesn't correspond to the number of Factors in my Factors list ?"

A Factor is only printed in the results for a particular year of the simulation if it was specified as active during that year. Check the Factor(s) to see if they are active (page 32).

"I keep getting a 'Help File not Found' error when I start Analogy"

The help files analogy.msg and analogy.ndx must be in the same directory as the program or in a directory in the DOS path.